

WHAT IS CLAIMED IS:

1. A method for forming a patterned photoresist layer, being used to form a patterned photoresist layer aligned with a predetermined wafer layer and comprising:

(a) forming a photoresist layer on a substrate;

5 (b) exposing the photoresist layer;

(c) measuring an overlay offset between exposed portions of the photoresist layer and the predetermined layer;

(d) determining whether the overlay offset is acceptable or not; and

(e) developing the photoresist layer if the overlay offset is acceptable.

10 2. The method of claim 1, further comprising the following process before the step (e) if the overlay offset is not acceptable:

repeating a step (f) of removing photoresist and the steps (a), (b), (c) and (d) in sequence for at least one cycle until the overlay offset is determined to be acceptable in step (d), wherein an exposure condition in step (b) of each cycle is calibrated according to the overlay offset measured in step (c) of the preceding cycle.

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3. The method of claim 1, wherein the step of exposing the photoresist layer produces a latent image in the photoresist layer, and the step of measuring the overlay offset comprises:

providing a laser beam; and

20 scanning the latent image with the laser beam and analyzing a signal generated from the laser scanning to derive the overlay offset.

4. A method for forming a patterned photoresist layer, being used to form a patterned photoresist layer aligned with a predetermined wafer layer and comprising:

(a) forming a photoresist layer on a substrate;

(b) using an exposure/overlay-measurement tool to expose the photoresist layer to form a latent image in the photoresist layer;

(c) using the exposure/overlay-measurement tool to measure an overlay offset between the latent image and the predetermined layer;

5 (d) comparing the overlay offset with a predetermined value; and

(e) developing the photoresist layer if the overlay offset is smaller than the predetermined value.

5. The method of claim 4, further comprising the following process before step (e) if the overlay offset is larger than the predetermined value:

10 repeating a step (f) of removing photoresist and the steps (a), (b), (c) and (d) in sequence for at least one cycle until the overlay offset is found to be smaller than the predetermined value in step (d), wherein an exposure condition in step (b) of each cycle is calibrated according to the overlay offset measured in step (c) of the preceding cycle.

6. The method of claim 5, wherein calibrating the exposure condition according to the overlay offset comprises:

feeding back a control signal generated based on the overlay offset to the exposure/overlay-measurement tool to order the exposure/overlay-measurement tool to calibrate the exposure condition.

7. The method of claim 4, wherein measuring the overlay offset comprises:

20 scanning the latent image with a laser beam provided by the exposure/overlay-measurement tool; and

analyzing a signal generated from the laser scanning to derive the overlay offset.

8. An apparatus for forming a patterned photoresist layer, being used to form a patterned photoresist layer aligned with a predetermined wafer layer and comprising:

a photoresist coating tool for coating a photoresist layer on a substrate;
an exposure/overlay-measurement tool for exposing the photoresist layer to form a latent image therein and for measuring an overlay offset between the latent image and the predetermined layer;

- 5 a development tool for developing the photoresist layer; and
a substrate carrying tool connected between the photoresist coating tool, the exposure/overlay-measurement tool and the development tool.

9. The apparatus of claim 8, further comprising a photoresist removal tool that is connected with the exposure/overlay-measurement tool via the substrate carrying tool.

- 10 10. The apparatus of claim 9, wherein the photoresist removal tool is connected with the photoresist coating tool via the substrate carrying tool.

11. The apparatus of claim 9, wherein the substrate carrying tool carries the substrate to the photoresist removal tool or the development tool according to the overlay offset value.

- 15 12. The apparatus of claim 8, wherein the exposure/overlay-measurement tool comprises:

an exposure module for forming a latent image in the photoresist layer; and
an overlay measurement module for measuring the overlay offset between the latent image and the predetermined layer and for feeding back a control signal generated
20 based on the overlay offset to the exposure module.

13. The apparatus of claim 12, wherein the exposure module comprises:

an exposure light source disposed over the substrate; and
a photomask disposed between the exposure light source and the substrate.

14. The apparatus of claim 12, wherein the overlay measurement module comprises:

a laser light source for scanning the latent image in the photoresist layer;

5 a signal reception device for receiving a test signal generated from the laser scanning that contains information of the overlay offset; and

a signal feedback device for generating the control signal based on the test signal and for feeding back the control signal to the exposure module.